

MAG REGIONAL FREEWAY BOTTLENECK STUDY

TASK 5 TRAFFIC DATA WORKING PAPER

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TRAFFIC DATA WORKING PAPER

An extensive amount of traffic data was collected for the Regional Freeway Bottleneck Study. The data was collected to meet two objectives:

- To have one representative 24-hour estimate of directional traffic volumes on approximately every three miles of the freeway mainline
- To collect the traffic data necessary to evaluate the bottleneck locations.

Traffic data was collected through an aerial photo-survey flown by Skycomp, Inc., video photography using both the ADOT Freeway Management System (FMS) cameras and portable cameras operated by ATD Northwest (ATD), and manual counts set by Traffic Research & Analysis (TRA). Data collection began on September 11, 2001 and continued into October. The methodology followed and the results of each are discussed in this chapter.

The data collection tasks of the Regional Freeway Bottleneck Study resulted in four products:

- An aerial photo-survey report, *Traffic Quality on the MAG Regional Freeway System*, prepared by Skycomp;
- A traffic data validation binder of data, prepared by Olsson Associates (because of its size, just one copy was prepared);
- An MS Access traffic count database, also prepared by Olsson Associates;
- A series of maps presenting the data, which are included in this working paper.

NOTE: THE TEXT OF THIS WORKING PAPER DOCUMENTS THE PROCESSES FOR COLLECTING, VALIDATING, AND REPORTING THE TRAFFIC DATA. THE COUNT DATA IS PRESENTED IN A SERIES OF MAPS IN APPENDIX C OF THE WORKING PAPER.

- *2001 Daily Traffic Volume (Figures 1 and 1A)*
- *2001 Daily HOV Lane Volume (Figure 2)*
- *2001 AM Peak Hour Traffic Volume (Figures 3 and 3A)*
- *2001 PM Peak Hour Traffic Volume (Figures 4 and 4A)*
- *2001 AM Peak Hour HOV Lane Volume (Figure 5)*
- *2001 PM Peak Hour HOV Lane Volume (Figure 6)*
- *2001 Daily Truck Volume (Figure 7)*
- *2001 AM Peak Hour Truck Volume (Figure 8)*
- *2001 PM Peak Hour Truck Volume (Figure 9)*

APPENDICES D, E AND F DEPICT THE DAILY, MORNING PEAK AND EVENING PEAK VARIATION IN TRAFFIC VOLUMES ON I-10 WB BETWEEN RIGGS ROAD AND OGLESBY ROAD

AERIAL PHOTO-SURVEY

In the fall of 2001, Skycomp conducted a series of aerial photo-surveys of highway traffic conditions in the planning region of the Phoenix metropolitan area. The purpose was to update information on traffic conditions and obtain other materials to support regional planning activities. Using the mobility and vantage point of fixed-wing aircraft, a photographic inventory of traffic conditions was made on approximately 175 miles of freeways during the peak morning and evening periods of commuter travel.

In the fall of 1998, a similar survey of the MAG regional freeway system was conducted, with approximately 110 miles of highway included. The 2001 survey was conducted using the same methodology, except that survey coverage was expanded by one hour for both the morning and evening peak periods.

During this aerial survey program, overlapping photographic coverage of designated freeways was obtained – repeated once an hour over four morning and four evening commuter periods. The morning times of coverage were 6:00-9:00 AM, and evening times were 3:30-6:30 PM. Survey flights were conducted only on weekdays, except that Monday mornings, Friday evenings, and mornings after holidays were excluded. Data were extracted from the aerial photographs such that, by link and by time slice, average recurring daily traffic conditions could be measured.

The *Traffic Quality on the MAG Regional Freeway System* report, prepared by Skycomp as a product of its efforts, presents the aerial photo-survey data in the following ways:

- Performance rating tables of traffic conditions on the 175 miles of surveyed freeways are presented for morning and evening peak periods. The ratings are presented in tables by highway segment, by direction, and by time slice. Each rating represents the average of approximately four flyovers (from four different days), minus any data affected by incidents (the half-hour time slices represent the average of two flyovers). The ratings are density-based level-of-service (LOS) designations "A", "B", "C", "D", "E" and "F", as defined in the *2000 Highway Capacity Manual* (HCM).
- The report also includes highway maps containing narratives that clarify the severity and frequency of all congestion found along each highway segment. Where evident, apparent causes of the problems are also described. Congestion on crossing freeways and on interchange ramps are also depicted and discussed.

Other aerial photo-survey results produced and submitted to MAG include:

- Queue populations at freeway on-ramps (ramp meters) and off-ramps (signal queues) have been recorded for each observation. Each entry also includes physical

characteristics of the ramp, including the number of lanes associated with each turning movement.

- An electronic version of the Survey Database (built in Microsoft Access) was produced. This database contains all of the collected data, from vehicle counts and road segmentation, to flight information and the variables used to calculate densities.
- An interactive CD-ROM *Congestion Highlights* slide show presents the findings of the report, plus many highlight aerial photographs of congestion. This product can be projected to audiences "as is"; the interactive feature allows a presenter to respond to audience interests by going to specific locations as they come up in the discussion.
- A second slide show, the *Peak-Traffic Photolog*, contains overlapping photographic coverage of the entire 175-mile system -- twice. Using actual survey photographs, typical peak-hour passes were selected during both morning and evening survey periods. These passes represent a snapshot of how the highway system looked on a typical day (as much as possible, passes were selected that did not include the effects of major incidents).

CAMERA/VIDEO COUNTS

ATD collected traffic data using video photography at 44 locations – 23 ADOT FMS locations and 21 locations where portable cameras were used. Of the 44 sites, 36 were mainline locations, where video was recorded in both directions, and 8 were ramp locations. The locations, type of camera used (FMS or portable), date the data was collected, and data prepared from the videos are provided in Appendix A. Ramp metering sites that were operational in September 2001 are listed in Appendix B.

The camera location counts utilized videotapes and a sampling procedure. The videotapes were viewed and the vehicles were manually counted for five-minute intervals for 20 hours, 4:00 AM to 12:00 midnight. From 4:00 to 6:00 AM, the first five-minute interval of each hour was counted. From 6:00 to 9:00 AM, the first five-minute interval of each fifteen minutes was counted. From 9:00 AM to 3:00 PM, the first five-minute interval of each hour was counted. From 3:30 to 6:15 PM, the first five-minute interval of each fifteen minutes was counted. From 7:00 PM to midnight, the first five-minute interval of each hour was counted.

The camera location counts were expanded to a full 24-hour volume. Each five-minute interval counted was multiplied by three to obtain an estimated 15-minute volume. During the periods when a five-minute interval was counted once per hour (off-peak hours), the 15-minute volume was utilized four times to represent a one-hour volume. The volumes for the time period from midnight to 4:00 AM were estimated by utilizing counts from similar stations with complete twenty-four hour counts – either tube or loop counts.

MANUAL COUNTS

TRA was responsible for all manual counts. Directional manual counts were collected by either pneumatic tubes (117 sites) or, when available and functional, using permanent loops (34 sites). The locations and data prepared at each location are also provided in Appendix A.

In summary, 233 ground directional traffic counts were obtained from four different sources. Arizona Department of Transportation Freeway Management System video cameras were utilized for 46 counts. ATD Northwest cameras were utilized for 36 counts. Pneumatic tubes were utilized for 117 counts. Arizona Department of Transportation permanent detector loops were utilized for 34 counts. One hundred sixteen tube and fifteen loop locations were counted for 15-minute intervals over a 48-hour period. One tube location and nineteen loop locations were counted for one-hour intervals over a 48-hour period.

COUNT VALIDATION PROCESS

With the large number of ground counts collected and counts coming from a variety of sources, it was important to critically investigate the counts to ensure the validity of the data. The validation process is discussed in this section.

All of the graphics and charts prepared and evaluated in the validation process were inserted into a three-ring binder and submitted to MAG. All attachments referred to in this section are included in the binder. Attachment 1 in the binder is the Data Collection Plan map.

Initial Inspection

In order to assess the reasonability of the data, the counts for each individual location were plotted. The standard plot consisted of a solid diamond connected by a solid line. Those locations with 15-minute counts were plotted in both 15-minute intervals and one-hour intervals. Those counts with five-minute counts were expanded to 15-minute intervals and plotted in both 15-minute and one-hour intervals. The camera counts that were expanded to 15-minute interval volumes for 24 hours were plotted with a long dashed line and an asterisk.

The locations with 48 hours of volume data were carefully examined. An average 24-hour total was calculated. If apparent differences occurred between the two 24-hour periods, then separate 24-hour totals were calculated for each day. If differences greater than 1,000 vehicles per day occurred between the average daily volume and the highest daily volume, the higher daily volume data was utilized. The plot of the discarded daily volume was changed to a short dashed line and an open diamond.

Attachment 2 (in binder) is a listing of the count stations that required traffic volume adjustments. Attachment 3 (in binder) is the individual plots of the fifteen-minute and hourly volumes for each of the 233 count stations.

Subsequent Inspection

Thirteen separate maps of mainline freeways were developed. The daily traffic counts were rounded to the nearest 500 vehicles per day and indicated on the maps. These counts were reviewed for logical progression. For example, US-60 experiences low traffic volumes in each direction at its eastern terminus. The traffic volumes increase in the western direction. Each count on each facility was examined from a similar perspective to ensure logical increase or decreases.

Nine separate maps of freeway-to-freeway interchanges were developed. The entering and exiting traffic counts were examined to ensure logical increases or decreases. Where possible, the percent difference between the measured counts and calculated counts was determined. The measured counts were at the approaches and departures of each interchange. The calculated counts began with the approach count, subtracted exit ramp counts and added entrance ramp counts resulting in a departure volume. The percent difference was determined as the difference between the counts divided by the average of the counts.

The percent difference at each of the count locations for all of the interchanges was relatively small. A percent difference between the measured count and the calculated count of 10% or less is accepted as valid. All but two interchanges had a percent difference of less than 10%. Considering that three different counting devices were utilized, and that counts occurred on different days of the week and months of the year, it is exceptional that the counts balanced within 10% or less for all but two locations. One interchange – I-10 to SR-101 – had a percent difference for the westbound traffic of 18%. Another interchange – I-10 to SR-202 to SR-51 – had a southbound percent difference of 11%.

At three freeway-to-freeway interchanges, it was not possible to calculate percent differences as the count stations were too far from the interchanges. At these locations, several entrance and exit ramps were present between the freeway-to-freeway interchanges and the closest count station. These interchanges were: I-17 to SR-101, I-17 to I-10, and SR-101 to SR-202. At these interchanges, some of the approach and departure volumes were calculated based on the exiting and entering counts at the freeway-to-freeway interchanges.

Attachment 4 (in binder) is a series of maps that provide the directional daily traffic volumes rounded to the nearest 500 vehicles and the count stations in various subsections of the freeway system. Attachment 5 (in binder) is a single map that provides the daily traffic volumes rounded to the nearest 1,000 vehicles for the entire freeway system.

In summary, the careful examination of the traffic counts verified the validity of the counts for future analysis.

MS ACCESS TRAFFIC COUNT DATABASE

The relational Traffic Count Database (MS Access) was compiled from three principal tables:

1. Count Sites
2. Counts-All Sites
3. Peak Periods & Hours-All Sites

The *Count Sites* table consists of one record for each count location/direction (totaling 791 records). Each record is uniquely identified by a Site ID. Each record fully identifies and describes a single site: its freeway, direction, location, the name of the file containing its counts, the date on which the counts were taken, the number of counts in the file, its count intervals (15-minute or 1-hour), etc.

The *Counts - All Sites* table contains the actual traffic count values for each site spanning a period of 24 hours in 15-minute increments. Thus the table contains 96 count records (24 hours times four 15-minute periods per hour) for each count site. The table is related to the *Count Sites* table via field the Site ID. This table includes fields for Total Volume, General Purpose Lanes Volume, HOV Lane Volume, Volumes in Lanes 1-6, and Class Volumes (for Light Duty, Medium Duty, and Heavy Duty Vehicles). Not all of these volume types are included for every count site. For example, relatively few of the count sites collected classification volumes. The table contains blanks wherever information was not collected.

The *Peak Periods & Hours - All Sites* table contains a single record for each count site (791 records), and again relates to the other tables via the Site ID. This table contains summed count volumes for four periods during the day: the AM Period (6:00 AM - 9:00 AM), the Mid Day Period (9:00 AM - 3:00 PM), the PM Period (3:00 PM - 6:00 PM), and the Night Period (6:00 PM - 6:00 AM). The table gives Total Volumes, General Purpose Lanes Volumes, and HOV Lane Volumes over each of these periods. The table also gives the Peak Hour (e.g.- 8:00 AM - 9:00 AM) during which the highest volume occurred in both the AM Period and the PM period.

The Traffic Count Database contains a number of smaller tables that are subsets of the *Counts - All Sites* table. The name of each of these subset tables begins with “Counts.” For example, the table named *Counts - Mainline By Class* includes only count values for count sites at which Class volumes were collected.